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TRINH, THANH TRUC	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/778,009	SCHER ET AL.	
	Examiner	**Art Unit**	
	THANH-TRUC TRINH	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 October 2009*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *104-111,113-126,128-140 and 286-303* is/are pending in the application.

4a) Of the above claim(s) *286* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *104-111,113-126,128-140 and 287-303* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 10/5/2009 has been entered.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claims 130-133, 302 and 303 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Claims 130-133 depend on claim 104 and recite the limitations related to architectures of a photovoltaic device such as "non-planar architecture", "convex architecture", "coiled architecture" and "reciprocating stacked architecture" as described in Figures 8A-8C, while claim 104 recites a different architecture such as “hermetically

sealed" as described in Figure 6. However, there is no support found for the combination of architectures cited in claims 130-133 and architecture in claim 104. For example, there is no adequate support found for a photovoltaic device carrying a combination of "hermetically sealed" and "non-planar architecture", or "hermetically sealed" with "convex architecture", or "hermetically sealed" with "coiled architecture", or "hermetically sealed" with "reciprocating stacked architecture", and especially on how to combine the configurations or combine the configurations in what way to indicate that such combination could be reasonably conveyed to the artisan that the inventor had possession at the time of the invention was made.

As newly added, claim 302 recites the limitation "the first and second electrode layers each comprise a conductive portion disposed in at least partial electrical contact with the first photoactive layer and a nonconductive portion surrounding the conductive portion, which nonconductive portion seals against the corresponding nonconductive portion of the opposing electrode layer, thereby hermetically sealing the photoactive layer" in lines 1-5. There is no support for the limitation found in the originally filed disclosure. Applicant points to paragraphs 203-204 for the support. However, there is nothing in paragraphs 203-204 describing each electrode layers comprises a conductive portion and a nonconductive portion <u>surrounding</u> the conductive portion. For the purpose of this action, the limitation will be treated as the first and second electrode layers each comprises a conductive portion and a nonconductive portion, the conductive portion of each of electrode layers makes at least partial electrical contact

with the photoactive layer and the nonconductive portions from first and second electrode layers hermetically seal the photovoltaic layer.

As newly added, claim 303 recites the limitation “the first and second electrode layers each comprises a flexible transparent layer, and wherein the conductive portion of each of the first and second electrode layers comprises an aluminum or magnesium conductive coating on the flexible transparent layer” in lines 1-4. There is no support for the limitation found in the originally filed disclosure. Instead, the original disclosure describes "such films may be readily coated or otherwise treated to render the film conductive, so that it may function as one of the electrodes of the device. In at least one preferred example, an aluminized polymer film is provided as the electrode layer. By employing an oxygen getter, e.g. aluminum, magnesium, etc., as the conductive coating on a flexible transparent layer, one can further reduce the potential for oxygen exposure" in paragraph 203. The description refers to the aluminum or magnesium coated flexible transparent layer is one electrode (e.g. one electrode out of two electrodes in the photovoltaic device). There is nothing in the description particularly pointing out each of the first and second electrodes (or both electrodes) comprising aluminum or magnesium coated flexible transparent layer.

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 130-133 and 302-303 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 130-133 depend on claim 104 and recite the limitations related to architectures of a photovoltaic device such as "non-planar architecture", "convex architecture", "coiled architecture" and "reciprocating stacked architecture" as described in Figures 8A-8C, while claim 104 recites a different architecture such as “hermetically sealed” as described in Figure 6. It is unclear how the configurations are combined (e.g. hermetically sealing the photoactive layer first then arranging the photoactive layer in non-planar architecture, coiled architecture or reciprocating stacked architecture; or vice versa). Furthermore, Applicant's specification does not have any sufficient description of how such combination of configurations or architectures possibly carried out.

As newly added, claim 302 recites the limitation “the first and second electrode layers each comprise a conductive portion disposed in at least partial contact with the first photoactive layer and a nonconductive portion surrounding the conductive portion, which nonconductive portion seals against the corresponding nonconductive portion of the opposing electrode layer, thereby hermetically sealing the photoactive layer" in lines 1-5. It is unclear how a conductive portion of each electrode layer surrounded by a nonconductive portion can partially make contact with the photoactive layer, wherein said photoactive layer is further hermetically sealed by the non-conductive portions of the opposing electrode layers. If a non-conductive portion surrounding the conductive portion of an electrode, the electrode will not contact the photoactive layer and function

as an electrode such as conducting electricity from/to the photoactive layer. For the purpose of this office action, the limitation will be treated as the first and second electrode layers each comprises a conductive portion and a nonconductive portion, the conductive portion of each electrode layers makes at least partial electrical contact with the photoactive layer, and the nonconductive portions from the first and second electrode layers hermetically seal the photoactive layer.

As newly added, claim 303 recites the limitation “the first and second electrode layers each comprises a flexible transparent layer, and wherein the conductive portion of each of the first and second electrode layers comprises an aluminum or magnesium conductive coating on the flexible transparent layer” in lines 1-4. It is unclear how the photoactive layer could absorb light when both electrodes comprising metal. It is also unclear as to how the photovoltaic device would convey the electrons converted from light when both electrodes having the same work function (e.g. made of metal). There is no description in Applicant’s specification indicating that each electrode (or both electrodes in the photovoltaic device) comprising an aluminum or magnesium conductive coating on a flexible transparent layer. Instead, the original disclosure describes "such films may be readily coated or otherwise treated to render the film conductive, so that it may function as one of the electrodes of the device. In at least one preferred example, an aluminized polymer film is provided as the electrode layer. By employing an oxygen getter, e.g. aluminum, magnesium, etc., as the conductive coating on a flexible transparent layer, one can further reduce the potential for oxygen exposure" in paragraph 203. The description refers to the aluminum or magnesium

coated flexible transparent layer is one electrode (e.g. one electrode out of two electrodes in the photovoltaic device). For the purpose of this office action, the limitation will be treated as in alternative form; that is, "the conductive portion of the first or the second electrode layers comprises an aluminum or magnesium conductive coating on the flexible transparent layer".

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

8. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was

not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

9. Claims 104-111, 113, 115, 118-119, 121-126, 128-131, 137-138 and 287-303 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nelles et al. (US 2002/0117201) in view of Salafsky et al. (US Patent 6239355) and further in view of Pettersson et al. (WO 01/97237).

Regarding claims 104-106, 110, 113, 115, 118-119, 293-294, 300 and 302, Nelles et al. teaches a photovoltaic device comprising a first electrode layer and a second electrode layer (e.g. electrode materials, EM; see paragraphs 0018-0029); a first photoactive layer (HTM/dye/SOL, or HTM/SOL) disposed between and in contact with the first and second electrode layers, wherein the photoactive layer comprises two sublayers of nanostructures such as TiO_2 nanocrystals (or SOL layer, see paragraph 0047) and a small molecule (or HTM layer) such as TPD (see paragraph 0037). The small molecule (e.g. TPD – N,N'-diphenyl-N,N'-bis-(3-methylphenyl)-(1,1'diphenyl)-4,4'-diamine) is a hole transporting material that can be used alone (see paragraph 0037); therefore the small molecule is a semiconductive molecule other than a dye, an organic nonpolymeric molecule and the photoactive layer is free of conductive polymer. Nelles et al. also teaches the photoactive layer (e.g. including HTM/dye/SOL or HTM/SOL) is disposed in at least partial contact with the first electrode and second electrode (e.g. electrode materials, EM in EM/HTM/dye/SOL/EM, EM/SOL/dye/HTM/EM or

EM/HTM/SOL/EM, see paragraphs 0017-0024) along a first and a second planes (e.g. the planes between EM and HTM layers, or between EM and SOL layers).

The differences between Nelles et al. and instant claims are the requirements of discrete nanostructures (or single-crystal nanostructures), and sealing hermetically the photoactive layer.

Salafsky teaches using discrete TiO_2 nanostructures (204) in a photoactive layer (e.g. layer 106 including nanoparticles 204, polymer 202) between and contacting two electrodes (104 and 108) along a first and a second planes (e.g. the horizontal planes of the electrodes 104 and 108 as seen in Figures 1-3) to form a photoactive channel architecture without requiring a passage to other nanoparticles (See abstract and col. 4 lines 3-31), wherein the nanostructures (204) of the first population each has at least one elongated section (e.g. section along the axis 208 as seen in Figure 2) oriented predominantly normal to at least the first plane (e.g. the elongate section is perpendicular to the horizontal plane of the electrode 104, see Figure 2). It would have been obvious to one skilled in the art at the time the invention was made to modify the device of Nelles et al. by using a population of discrete nanostructures oriented such that the elongate section is normal to the plane of the contacted electrode as taught by Salafsky, because Salafsky teaches such population would provide a photoactive channel architecture without requiring a passage to other nanoparticles (See abstract and col. 4 lines 3-31 of Salfasky).

As seen in Figure 3, Pettersson et al. teaches a first electrode comprising a conductive portion (e.g. conductive layer 4) and a nonconductive portion (e.g. flexible

supporting layer 3 with exposing areas 5), and a second electrode comprising a conductive portion (e.g. counterelectrode 8) and a nonconductive portion (e.g. sealing 10 including 10A and 10B), wherein the nonconductive portions (layers 10 and 3) are pressed against each other (including the nonconductive portions against each other such as 10 against exposing area 5) hermetically seal the photoactive layer (e.g. including the photoelectrode 6 and insulator containing electrolyte transport layer 7 as seen in figures 1-5 and 8) to cover and insulate the device from the surrounding environment to prevent dirt or moisture penetrating the cells (see page 7, lines 4-24 and page 10, lines 11-23 of Pettersson et al). It would have been obvious to one skilled in the art at the time the invention was made to use substrates and press down the substrates onto the device of modified Nelles with exposed EM layers (e.g. electrode materials layers) as taught by Pettersson et al. to hermetically seal (e.g. cover and insulate) the device of modified Nelles from the surrounding environment, because Pettersson et al. teaches such sealing would prevent dirt or moisture penetrating the cells (See last paragraph of page 2 through second paragraph of page 4; or page 10 lines 11-23). In such modification, the first and second electrode layers each comprises a conductive portion (e.g. EM of Nelles) disposed in at least partial electrical contact with the photoactive layer (e.g. photoactive layer of Nelles) and a non-conductive portion (e.g. substrate layers from Pettersson et al.) attaching to the conductive portion so that the non-conductive portions (e.g. each from one electrode) seal against the each other (e.g. because the substrates were pressed down against each other) thereby hermetically sealing the photoactive layer.

Regarding claim 107, the molecular weight of TPD is 516.67.

Regarding claim 108, TPD conducts holes (See paragraph 0037 of Nelles).

Regarding claims 109, 111, 287 and 295, as seen in Figure 2, Salafsky teaches the nanostructures (e.g. 204) disposed in a hole conducting material (e.g. 202). Nelles et al. teach the hole conducting material comprising a small molecule such as TPD in an admixture of nonconducting polymer. (See paragraph 0037 of Nelles et al.). In the combination of Nelles et al. in view of Salafsky, it would have been obvious that the nanostructures are disposed in a matrix comprising the small molecule dispersed in a nonconductive polymer.

Regarding claims 121-122, modified Nelles et al. teaches a photovoltaic device as described in claim 104 above. Modified Nelles et al. does not teaches comprising a hole blocking layer disposed between the photoactive layer and the first electrode, and an electron blocking layer disposed between the photoactive layer and the second electrode. As seen in Figure 3, Salafsky discloses a hole blocking layer (301 disposed between the photoactive layer (106) and the first electrode (104), and electron blocking layer (302) disposed between the photoactive layer (106) and the second electrode (108 - See col. 5 lines 25-56). It would have been obvious to one skilled in the art at the time the invention was made to incorporate the blocking layers as taught by Salafsky in the device of modified Nelles et al. as described in claim 104, because Salasky teaches such blocking layers would allow only one charge carrier type to pass to the underlying

contact and thereby reduces charge recombination at the electrode-photoactive layer interface. (See col. 5 lines 43-56).

Regarding claims 123-124, Nelles et al. teaches the first and second electrodes and the photoactive layers are flexible (e.g. as the whole cell is flexible, see paragraphs 0035-0047 of Nelles).

Regarding claim 125, Nelles et al. teaches at least one of the first and second electrodes comprises a transparent conductive layer (see paragraphs 0021, 0035 of Nelles et al.).

Regarding claim 126, Nelles et al. teaches at least one of the electrodes comprises aluminum (see paragraph 0035 of Nelles et al.).

Regarding claims 128-129, Pettersson et al. teaches first and second sealing layers (see substrates 3 and 10 in Figures 1-3) in addition to the first and second electrodes (e.g. conductive layer 4 and counter electrode 8), wherein the photoactive layer (e.g. including photoelectrode 6 and electrolyte charge transport layer 7) and first and second electrodes (e.g. 4 and 8) are sandwiched between the first and second sealing layers (e.g. 3 and 10). The first and second sealing layers (e.g. 3 and 10) encompass the entire photoactive layer (e.g. including layers 6 and 7) as substrate 10 is pressed down to cover the inner and outer edge to insulate the device from the surrounding environment (see page 7, lines 4-24; page 10, lines 11-23).

Regarding claims 130-131, Nelles et al. teaches the photovoltaic device is flexible (see paragraph 0046 of Nelles et al.). Salafsky describes the photovoltaic device can be curvi-linear or mechanically flexible col. 6 lines 41-60 of Salafsky). Pettersson et

al. also teaches the photovoltaic device is flexible (see 2nd paragraph of page 6 of Pettersson). Therefore in the combination it would have been obvious to one skilled in the art that the device of modified Nelles et al. can be a non linear architecture or a convex architecture, because there is nothing unobvious about a flexible, curvi-linear or mechanical flexible device can have a non-linear architecture or a convex architecture. It has been held that a change in configuration of shape of a device is obvious, absent persuasive evidence that a particular configuration is significant. *In re Dailey*, 357 F.2d 669, 149 USPQ 47 (CCPA 1966).

Regarding claims 137-138, Nelles et al. does not specifically teaches the photovoltaic device further comprises a third electrode layer, a fourth electrode layer, and second photoactive layer; wherein the second photoactive layer is disposed between the third and fourth electrode layers, in at least partial electrical contact with the third electrode layer along a third plane and in at least partial electrical contact with the fourth electrode layer along a fourth plane, and comprises a second population of nanostructures having a different absorption spectrum from the first population of nanostructures; wherein the third electrode layer, the fourth electrode layer and the second photoactive layer are attached to, but electrically insulated from the first electrode layer, second electrode layer and first photoactive layer . As seen in Figure 3, Salafsky discloses a second photoactive layer (308) disposed between and partially electrical contact with a third electrode layer (306 and 307) and a fourth electrode layer (310 and 312). The second photoactive layer comprises a second population of nanostructures having a different absorption spectrum from the first population of

nanostructure (See col. 5 line 57 through col. 6 line 4), and wherein the third and fourth electrodes and second photoactive layer are attached to, but electrically insulated by isolation layer 304 from the first electrode (e.g. 104), second electrode (e.g. 108) and first photoactive layer (e.g. 106). (See col. 5 line 26 through col. 6 line 4). It would have been obvious to one skilled in the art at the time the invention was made to further include a third electrode layer, a fourth electrode layer and a second photoactive layer as taught by Salafsky within the sealing of modified Nelles et al's device, because Salafsky teaches modification would provide a stacked configuration that is useful in detecting multiple wavelengths of incident light. (See col. 5 line 25 through col. 6 line 4)

Regarding claims 288-291 and 296-299, Nelles et al. teaches the small molecules such as hole transporting material TPD can be used alone or in a mixture with polymers (e.g. non-conductive polymers, see paragraph 0037), but reference does not explicitly disclose specific percentage or amount of greater than 50%, or greater than 75%, or greater than 90% or greater then 95% of the small molecule in the matrix comprising the small molecule and a nonconductive polymer. As the matrix (e.g. conductive molecule such as TPD and nonconductive polymer) is designed to be conductive in the photovoltaic device (e.g. as the TPD is designed to form the HTM or hole transporting material layer), the conductivity of the matrix (or the HTM layer) is a variable that can be modified, among others, by adjusting the percentage or amount of small molecule (e.g. TPD), with said conductivity of the matrix (or HTM layer) increasing as the percentage or amount of small molecule in the matrix is increased, the precise percentage or amount of the small molecule in the matrix would have been considered

as a result effective variable by one having ordinary skill in the art at the time the invention was made. As such, without showing unexpected results, the claimed percentage or amount of small molecule in the matrix cannot be considered critical. Accordingly, one of ordinary skill in the art at the time the invention was made would have optimized, by routine experimentation, the percentage or amount of small molecule in the matrix in the modified Nelles et al. to obtain the desire the conductivity of the matrix (*In re Boesch*, 617 F.2d. 272, 205 USPQ 215 (CCPA 1980)), since it has been held that where the general conditions of the claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. (*In re Aller*, 105 USPQ 223).

Regarding claims 292 and 300, modified Nelles et al. teaches a photovoltaic device as described in claims 109 and 294 above, wherein Nelles et al. teaches the small molecule (e.g. TPD) can be used alone (see paragraph 0037). In other words, the small molecule comprises 100% of the matrix by weight.

Regarding claim 301, Nelles et al. teaches the electrode is of substrate + EM, wherein the substrate is a flexible polymeric foil like PET, PEN or PI (see paragraphs 0018-0029, 0034) and the EM is of Al (see paragraph 0035). In other words, Nelles et al. teaches an electrode comprising an aluminized polymer film.

Regarding claim 303, Nelles et al. teaches the electrode (e.g. substrate + EM) is made of Al or Mg (see paragraph 0035) coated on a flexible transparent layer (e.g. substrate, see paragraph 0034).

10. Claims 114, 116-117 and 120 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nelles et al. (US 2002/0117201) in view of Salafsky (US Patent 6239355) and further in view of Petersson et al. (WO 01/97237) as applied to claim 104, and further in view of Alivisatos et al. (US 2003/0226498)

Regarding claims 114, 116-117 and 120, modified Nelles et al. teaches a photovoltaic device as described in claim 104 above.

Nelles et al. in view of Salafsky and Pettersson et al. does not specifically teaches the nanostructures comprise nanowires, at least a portion comprises a semiconductor selected from the group consisting of a Group II-VI semiconductor, a Group III-V semiconductor, a Group IV semiconductor; nor do they teach branched nanocrystals having more than one elongated segment.

Alivisatos et al. teaches nanostructures comprises nanorods of any length, or nanowires. (See paragraph 0061)

Alivisatos et al. further teaches the nanostructures comprise a Group II-VI semiconductor such as ZnS, ZnSe, ZnTe, CdS, CdSe, CdTe, HgTe, a Group III-V semiconductors such as GaAs, GaP, GaAs, GaSb, InAs, InP, InSb, AlAs, AlSb, and a Group VI semiconductors such as Ge or Si. (See paragraph 0065).

Alivisatos et al. also teach the nanostructures comprise branched nanocrystal having more than one elongated segment. (See paragraphs 0061-0064)

It would have been obvious to one skilled in the art at the time the invention was made to modify the device of Nelles et al. in view of Salafsky and Pettersson et al. by

using nanostructures as taught by Alivisatos et al., because it would improve efficiency. (See paragraph 0073 of Alivisatos et al.)

11. Claim 132 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nelles et al. (US 2002/0117201) in view of Salafsky (US Patent 6239355) and further in view of Pettersson et al. (WO 01/97237) as applied to claim 104, and further in view of Hanak (US Patent 4713492)

Regarding claim 132, modified Nelles et al. teaches a photovoltaic device as described in claim 104 above.

Nelles et al. in view of Salafsky and Pettersson et al. does not specifically teach the photoactive layer and the electrodes are oriented in a coiled architecture. However, Nelles et al. teaches the photovoltaic device is flexible (see paragraph 0046 of Nelles et al.). Salafsky describes the photovoltaic device can be curvi-linear or mechanically flexible col. 6 lines 41-60) to be suitable for building applications among others (See col. 6 lines 41-46 of Salafsky). Salafsky also teaches the photoactive material layer are in the range of nanometers, wherein the semiconductor particles have an average diameter about few nanometers to hundreds of nanometers (See col. 4 lines 54-63 of Salafsky) and the and conjugated polymer has a thickness in the range of one to two times the average diameter of the nanoparticles. (See col. 2 lines 46-53 of Salafsky). Pettersson et al. also teaches the substrates of plastic are very flexible, and the whole device is flexible (see paragraph of page 2 bridging page 3; second paragraph of page 6 of Salafsky). Therefore the device of modified Nelles is flexible and bendable since

the substrate, electrodes are flexible and the photoactive material layer is thin enough to be flexible.

Hanak teaches a flexible photovoltaic device (e.g. including the first electrode 22, the photoactive layer 12a-12c, and the second electrode 11 as seen in Figure1, col. 26-65) can be rolled into a coiled configuration (e.g. being rolled into a compact stowable cylindrical configuration, see abstract, figures 2D and 5, col. 9 lines 21-38 and col. 11 lines 46-50).

It would have been obvious to one skilled in the art at the time the invention was made to arrange the flexible photovoltaic device of modified Nelles et al. (e.g. the first electrode, the photoactive layer and the second electrode as described in claim 104) in a coiled configuration (e.g. helically rolled) as taught by Hanak, because Hanak teaches such arrangement would allow a large area photovoltaic device to be readily for stowage or storage (See abstract, col. 9 lines 21-38 and col. 11 lines 46-50)

12. Claim 133 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nelles et al. (US 2002/0117201) in view of Salafsky (US Patent 6239355) and further in view Pettersson et al. (WO 01/97237) as applied to claim 104 above, and further in view of Strebkov et al. (US Patent 4151005)

Modified Nelles et al. teaches a photovoltaic device as described in claim 104.

However, Nelles et al. in view of Salafsky and Pettersson et al. does not specifically teach arranging the first electrode, the photoactive layer and the second electrode in a reciprocating stacked architecture.

Salafsky teaches the electrode and photoactive layers can be stacked (See Figure 3 of Salafsky). As seen in Figure 7, Strebkov et al. teaches arranging the first electrode layer (e.g. current collector 5), the second electrode layer (e.g. 11) and the photoactive layer (e.g. including layers between electrodes 5 and 11) in a reciprocating stacked architecture. (see col. 1 line 13 through col. 12 lines 18)

It would have been obvious to one skilled in the art at the time the invention was made to arrange the first electrode layer, the photoactive layer and the second electrode layer of modified Nelles et al. in a reciprocating architecture as taught by Strebkov et al., because Strebkov et al. teaches such arrangement would give higher radiation resistance and efficiency to the photovoltaic generator (see col. 11 lines 38-49) and Salafsky suggests the stacked architecture would provide a photovoltaic device that can detect multiple wavelengths of incident light (See col. 5 line 25 through col. 6 line 4).

13. Claims 134-136 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nelles et al. (US 2002/0117201) in view of Salafsky (US Patent 6239355) and further in view of Pettersson et al. (WO 01/97237) as applied to claim 104 above, and further in view of Simmons et al. (US Patent 5720827).

Modified Nelles et al. teaches a photovoltaic device as set forth.

Modified Nelles et al. does not specifically teach the first population of nanostructures comprising at least two different nanocrystal subpopulations, wherein each nanocrystal subpopulation has different absorption spectrum; different nanocrystal

subpopulation comprises different compositions; different nanocrystal subpopulations comprises nanocrystals having different size distribution.

With respect to claims 134 and 136, as seen in Figure 2, Simmons teaches a nanostructure population in a photoactive layer (e.g. photoactive region 20) comprises at least two different nanocrystal subpopulations (22, 26, 28, 30, 32), wherein the subpopulations have different size and each subpopulation has different absorption spectrum. (See col. 5 lines 45-65 and col. 7 line to col. 8 line 15 of Simmons)

With respect to claim 135, as seen in Figure 5, Simmons teaches a nanostructure population in a photoactive layer (e.g. photoactive region 20) comprises at least two different nanocrystal subpopulation (20A and 20B), wherein each subpopulation comprises different compositions, or different material. (See col. 13 lines 13-50 of Simmons).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to include at least two different nanocrystal subpopulations with different size, composition and absorption spectrum as taught by Simmons in the photoactive layer of the device of modified Nelles et al, because it would give a photoactive layer that can efficiently absorb the entire range of incident optical radiation. (See col. 8 lines 14-16 of Simmons)

14. Claims 139-140 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nelles et al. (US 2002/0117201) in view of Salafsky (US Patent 6239355) and further in

view of Pettersson et al. (WO 01/97237) as applied to claim 104 above, and further in view of Ono (PGPub 20030013008).

Regarding claims 139-140, modified Nelles et al. teaches a photovoltaic device as set forth.

Nelles et al. in view of Salafsky and Pettersson et al. does not specifically teach a third electrode layer and a second photoactive layer disposed between the second and third electrodes layers, wherein the second photoactive layer is disposed in at least partial electrical contact with the second electrode and in at least partial electrical contact with the third electrode. Nor do they teach a second photoactive layer, and a first recombination material disposed between the first and second photoactive layers, wherein the first recombination material is in at least partial electrical contact with the first and second photoactive layers.

As seen in Figure 21(d), Ono describes a composite light-receiving device comprising a first and second photoactive layers (710 and electrolyte which can be a conductive polymer – See paragraph 0261 and 0119-0122) each disposed on a conductive substrate (see 700, or first and second electrodes), a third electrode (800), which is also the first recombination material in claim 140, disposed between the first and second photoactive layers (between the layers of 710 and electrolyte). In other words, the second photoactive layer is disposed in at least partial electrical contact with the second electrode and in at least partial electrical contact with the third electrode, or the first recombination material (or electrode 800).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the device of Nelles et al. in view of Salafsky and Pettersson et al. by including a second photoactive and a third electrode (or a first recombination material) as taught by Ono, because it would provide a device that can response to different types of light. (See paragraphs 0012 or 0216). In such combination, it would have been obvious to one skilled in the art that the device of modified Nelles et al. having the second photoactive layer is disposed in at least partial electrical contact with the second electrode and in at least partial electrical contact with the third electrode.

Response to Arguments

15. Applicant's arguments with respect to claims 104-111, 113-126, 128-140 and 287-303 have been considered but are moot in view of the new ground(s) of rejection.

Applicant's arguments about hermetically sealing the photoactive layer and architectures of the photovoltaic device are moot in view of the new ground of rejection. As seen in the rejection above, Pettersson et al. teaches hermetically sealing the photoactive layer to prevent dirt and moisture penetrating the cells. Therefore it would have been obvious to one skilled in the art to hermetically seal the photoactive layer of modified Nelles et al. to obtain the advantages taught by Pettersson et al.

With regards to Applicant's arguments regarding the non-planar and convex architectures, Nelles et al. teaches the photovoltaic device is flexible (see paragraph 0046 of Nelles et al.). Salafsky describes the photovoltaic device can be curvi-linear or

mechanically flexible col. 6 lines 41-60 of Salafsky). Pettersson et al. also teaches the photovoltaic device is flexible (see 2nd paragraph of page 6 of Pettersson). Therefore in the combination it would have been obvious to one skilled in the art that the device of modified Nelles et al. can be a non linear architecture or a convex architecture, because there is nothing unobvious about a flexible, curvi-linear or mechanical flexible device can have a non-linear architecture or a convex architecture as set forth above.

With regards to Applicant's arguments regarding the coiled architecture, Hanak teaches a flexible photovoltaic device (e.g. including the first electrode layer, the photoactive layer and the second electrode layer) can be configured in a coiled architecture to be ready for stowage or storage. Therefore it would have been obvious to one skilled of the art at the time the invention was made to configure the flexible photovoltaic device of modified Nelles et al. into a coiled architecture as taught by Hanak, because such architecture would be provide the flexible photovoltaic device ready for stowage and storage (See abstract, col. 9 lines 21-38 and col. 11 lines 46-50 of Hanak).

With regards to Applicant's arguments regarding reciprocating stacked architecture, Strebkov et al. teaches arranging the first electrode, the photoactive layer and the second electrode in a reciprocating architecture to obtain higher efficiency. It would have been obvious to one skilled in the art to arrange the photovoltaic device of modified Nelles et al. in a reciprocating architecture as taught by Strebkov et al., because such arrangement would give higher radiation resistance and efficiency to the photovoltaic device (see col. 11 lines 38-49 of Strebkov et al.)

Conclusion

16. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. US Patent 3411050 is related to hermetically sealing for a photovoltaic device.

17. Any inquiry concerning this communication or earlier communications from the examiner should be directed to THANH-TRUC TRINH whose telephone number is (571)272-6594. The examiner can normally be reached on 8:30 am - 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Basia Ridley can be reached on 571-272-1453. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

TT
10/19/2009

/Basia Ridley/
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